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Abstract

This paper investigates the extent to which trade facilitation measures included in the WTO Trade Facilitation Agreement affect tariff evasion. In a dataset covering 121 countries and the whole set of HS6 product categories in 2012, 2015, and 2017, the paper shows that trade facilitation measures that improve legal certainty for traders moderate tariff evasion. Holding tariff rate constant at its mean, one standard deviation improvement in trade facilitation measures related to legal certainty reduces tariff evasion, as measured by missing imports in trade statistics, by almost 12%. In a counterfactual with full trade liberalization, countries with higher scores on facilitation measures related to legal certainty experience larger reductions in tariff evasion than countries with lower scores on these measures, even for similar initial tariff rates. We investigate potential channels and show that improving legal certainty is effective in reducing tariff evasion due to under-reporting of import prices and under-reporting of import quantities, as well as in countries with weakest control of corruption.

Keywords: Tariff; International Trade Agreements; WTO; Tariff Evasion.

JEL Classification: F13; F14; H26.

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1 Introduction

Customs agencies worldwide control the flow of goods across borders in order to collect taxes and apply customs regulations. Customs agencies are a key focal point for collecting revenue, since they can regulate between 20% and 100% of an economy's output (Michael, 2012). Consequently, customs agencies can be quite demanding in their effort to verify each consignment's value, for example, by soliciting a number of documents from the trader. Costly customs procedures can incentivize traders to engage in customs evasion. Although global estimates are scarce, Kar and Spanjers (2014) estimate an outflow of US$ 729 billion in trade misinvoicing from developing countries in 2012. The losses from customs evasion are especially critical for low income countries that rely significantly on trade tariff revenue (Jean and Mitaritonna, 2010).[1] Regulating customs evasion should therefore be of paramount interest for trade policy.

Existing literature on measures to curb customs evasion has found mixed evidence of their efficacy. For example, Yang (2008) finds that increased pre-shipping inspection (PSI) in Philippines reduced evasion through the targeted method but raised evasion through an alternative duty-avoidance method. Similarly, Javorcik and Narciso (2017) finds that WTO accession, which mandates using exporter invoices in order to undermine arbitrary valuation of merchandise, led to displacement of tariff evasion to an alternative method. These studies conclude that the overall effect of such measures on customs evasion could be insignificant.

This paper contributes to the literature by documenting the effect of simplifying customs procedures on tariff evasion. We hypothesize that easing customs procedures should reduce the incentive for traders to misrepresent merchandise value in order to avoid high transaction costs. Indeed, evidence suggests that simplifying customs procedures has a dampening effect on tariff evasion. In particular, improving legal certainty of border procedures has a significant role in reducing tariff evasion.

[1] Baunsgaard and Keen (2010) report that the share of trade tax revenue in total tax receipts for 2001-2006 was 2.5% for high income countries, 18.1% for middle-income countries and 22% for the low-income countries. Kar and Spanjers (2014) estimate that about 7% to 13% of the government revenue in the five African economies of Ghana, Kenya, Mozambique, Tanzania and Uganda could potentially be lost due to customs misinvoicing.

Our analysis focuses on the provisions of the WTO Trade Facilitation Agreement (TFA). The TFA addresses fees and formalities related to import or export transactions, publication and administration of trade relations, as well as to the transitory aspects of international trade (Neufeld, 2014). The agreement aims to reduce transaction costs by expediting release of goods, by reducing border crossing requirements, and by increasing transparency (Neufeld, 2014).[2]

We study the effect of eleven measures that (with the exception of one) mirror the key provisions of the TFA, on the sensitivity of misrepresenting import value to the tariff rate faced by importers. We follow the literature and capture the misrepresentation of import value using the discrepancy in value of exports reported by all exporting countries to the importing country and the value of imports reported by the importing country from all countries (Fisman and Wei, 2004). The discrepancy is calculated at the six digit level of the Harmonized System (HS) classification, and is referred to as missing imports. We estimate the effect of trade facilitation measures on the sensitivity of missing imports to the tariff rate in each product category, importer and year using a dataset that comprises of 121 countries and the entire set of HS6 product categories in three years, 2012, 2015 and 2017.

The empirical analysis proceeds in several steps. First, we show that there is a positive association between tariff rate and missing imports. The point estimate suggests that 1% increase in tariff rate increases missing imports by 0.3%. This result, obtained in a large set of countries and products, highlights that tariff evasion is a global phenomena.

We next examine if trade facilitation measures weaken the positive relationship between tariff rate and missing imports. Figure 1 presents motivating evidence in favour of the hypothesis that improving trade facilitation performance weakens the relationship between tariff rate and missing imports. It plots missing imports (vertical axis) on the HS6 product tariff rate (horizontal axis). The dashed line represents products in countries that are above the sample

[2]The Trade Facilitation Agreement differs from earlier multilateral agreements since it eschews a one-size-fits-all model and encourages individual members to adopt policies that are most effective in reducing trade costs.

median of trade facilitation performance; the solid line represents products in countries which are below this sample median. In countries with low trade facilitation performance we find a positive and statistically significant effect of tariff rate on missing imports. Conversely, in countries with high trade facilitation performance the slope of the regression line is statistically not different from zero.

<< Figure 1 about here >>

The role of trade facilitation performance in weakening the relationship between tariff rate and missing imports is also substantiated in our regression analysis, where we control for unobserved country and product specific characteristics that can vary over time, along with controlling for unobserved product specific characteristics that are specific to a country. The point estimate suggests that holding tariff rate constant at the sample mean, one standard deviation improvement in trade facilitation performance reduces missing imports by 6.04%. We then unpack the effectiveness of different trade facilitation measures, and find that improving legal certainty significantly weakens the positive effect of tariff rate on missing imports. The point estimate suggests that holding tariff rate constant at mean, one standard deviation improvement in legal certainty reduces missing imports by almost 12%.

We conduct a series of robustness checks to verify our baseline findings that improving trade facilitation performance is effective in reducing tariff evasion, and this relationship is driven by the measure of legal certainty. In particular, we account for the possibility that missing imports in an HS6 product category could affect the country-level trade facilitation policy. We address the potential reverse causality by dropping the most important sectors according to their import share in each country. We argue that missing imports in these sectors are most likely to influence trade facilitation policy, and excluding these sectors should minimize the plausible reverse causality. Results show that excluding these sectors have no effect on our baseline findings. We conclude that reverse causality is unlikely to be a factor in our empirical

estimation.

We further examine which potential channels of tariff evasion are sensitive to improving legal certainty of border procedures. Existing literature identifies three main channels of tariff evasion: mis-classification of the product as a lower tax variety (Fisman and Wei, 2004); under-reporting of import prices (Javorcik and Narciso, 2008, 2017); and under-declaration of import quantities (Rotunno and Vézina, 2012). We find that improving legal certainty is effective in dampening tariff evasion that occurs through under-reporting of import prices or through under-declaration of import quantities.

Finally, we consider if the relationship between improving legal certainty and tariff evasion is mediated by other country-level characteristics. In particular we examine if the relationship between legal certainty and tariff evasion is sensitive to country-level control of corruption. We hypothesize that importers in countries with weak control of corruption may find it easier to offer customs officials side payments and avoid detection. Improving legal certainty of border procedures can reduce the discretionary power of customs officials to apply rules arbitrarily. Hence legal certainty can have an additional dampening effect on tariff evasion through harmonizing rules in countries with weak control of corruption. Results are in line with our conjecture and confirm that improving legal certainty has an additional effect on dampening tariff evasion in such countries.

This paper contributes to the literature in several ways. Our main contribution is to the literature on measures to reduce tariff evasion. This literature mainly examines the effectiveness of pre-shipment inspections (PSI), that are carried out by private surveillance companies, and were introduced in some low income countries as a precursor to customs reforms (Anson, Cadot, and Olarreaga, 2006, Ferreira, Engelschalk, and Mayville, 2007, Yang, 2008, Sequeira, 2016). The literature finds mixed evidence on their efficacy, mostly due to the creation of perverse incentives for importers and customs officers, and due to poor coordination between PSI vendors and customs administration. Recently, Javorcik and Narciso (2017) look at the mandatory use

of export invoices to undermine arbitrary merchandise valuation, following a country's accession to WTO, and conclude that the overall effect on tariff evasion is insignificant. Our study in contrast shows that simplifying customs procedures, and in particular improving legal certainty of border procedures, has a robust effect on dampening tariff evasion.

A second contribution is to the empirical literature on the impact of the Trade Facilitation Agreement (Moïsé and Sorescu, 2013, Hillberry and Zhang, 2018, Fontagné, Orefice, and Piermartini, 2020). The literature finds a significant variation in the effectiveness of different trade facilitation measures in reducing trade costs. The effectiveness of trade facilitation measures can vary across countries due to the level of development (Moïsé and Sorescu, 2013) or competition within sectors (Fontagné, Orefice, and Piermartini, 2020). In line with the literature, we also observe a significant variation in the effectiveness of trade facilitation measures in reducing tariff evasion.

We finally contribute to the literature on tariff evasion. Existing studies either identify tariff evasion among only a few countries (Fisman and Wei, 2004, Javorcik and Narciso, 2008, Moïsé and Sorescu, 2013, Rotunno and Vézina, 2012), or their data structure does not account for variation over time (Jean and Mitaritonna, 2010) or differences between product categories (Kellenberg and Levinson, 2019). Our work, in contrast, finds evidence for tariff evasion in a dataset that covers 121 countries and all HS6 product categories for three years in the period from 2012 and 2017. We therefore complement the literature and confirm that tariff evasion is a ubiquitous phenomena.[3]

The rest of the paper is organized as follows. In Section 2 we present a conceptual framework to guide our empirical analysis. We introduce the empirical strategy and describe the data in Section 3. Section 4 presents the main findings. Section 5 concludes.

[3]Recent work by Bussy (2020) also uses a country-product panel dataset and ascertains the pervasive nature of tariff evasion.

2 Conceptual framework

Consider a representative firm that imports a fixed amount into a country. The firm can evade a fraction of taxable amount by under-reporting the true value of the consignment. The incentive to evade taxes should therefore increase with the tariff rate.[4] The customs agency can respond to greater likelihood of evasion at a higher tariff rate by imposing a higher threshold for verification. For example, the customs agency can systematically seek more documents or physically inspect the consignment, in order to verify the consignment value for goods that are charged a high tariff rate. In other words, the cost of customs verification for a firm can also increase with the tariff rate. Therefore, a representative firm may have an additional incentive to engage in tariff evasion in order to avoid the high procedural costs. Trade facilitation measures, by simplifying customs procedures, should reduce a firm's incentive to engage in tariff evasion.

Proposition 1 *Improving trade facilitation measures should weaken the positive effect of tariffs on customs evasion.*

The relationship between trade facilitation and tariff evasion can be mediated by other factors. Customs agencies may lack the capacity to systematically apply verification procedures. A firm's cost of evasion should increase with the quality of imperfect customs enforcement (Mishra, Subramanian, and Topalova, 2008). When the quality of enforcement is low, the firm can avoid detection by offering customs officials side payments (Ferreira, Engelschalk, and Mayville, 2007). Trade facilitation measures, by harmonizing customs procedures, weaken the discretionary power of customs officials to arbitrarily apply rules. Therefore, trade facilitation measures can have a greater impact in curbing tariff evasion in countries with weak control of corruption.

[4]The prediction is in line with models of tax evasion that show a positive relationship between tax rate and tax evasion (Allingham and Sandmo, 1972). Fisman and Wei (2004), in a seminal paper, find evidence of tariff evasion in trade between Hong Kong and China.

Proposition 2 *Improving trade facilitation measures should further weaken the effect of tariffs on customs evasion in countries with weak control of corruption.*

3 Empirical strategy

We first estimate the reduced form effect of tariff on customs evasion using the following specification:

$$mi_{ikt} = \beta_1 \tau_{ikt} + \mathbf{FE}_{it} + \mathbf{FE}_{kt} + \mathbf{FE}_{ik} + \epsilon_{ikt}, \tag{3.1}$$

where mi_{ikt} (missing imports) measures evasion at the importer-HS6 product-year (ikt) level. Following Fisman and Wei (2004), we calculate dependent variable as the difference in log value of exports reported by all exporting countries to importing country i in sector k at time t (X_{ikt}) and the log value of imports reported by country i from all countries (M_{ikt}):

$$mi_{ikt} \equiv \ln(1 + X_{ikt}) - \ln(1 + M_{ikt}). \tag{3.2}$$

In equation (3.1), τ_{ikt} represents the tariff rate in HS6 product category within importer i in year t. Importer-year fixed effects $\mathbf{FE}_{it}$ account for unobserved country-level characteristics, such as corruption level or trade policy, that could change over time. Product-year fixed effects $\mathbf{FE}_{kt}$ account for unobserved product level characteristics, such as homogenizing consumption patterns, that can evolve over time (Kónya and Ohashi, 2007). Finally, importer-product fixed effects $\mathbf{FE}_{ik}$ account for unobserved product level characteristics, such as the political influence of sector k, that are specific to importing country i. β_1 measures the tariff semi-elasticity of missing imports. A priori, $\beta_1 > 0$, i.e. higher tariff rate is associated with larger missing imports in an HS6 product category.

We first estimate tariff semi-elasticity in a sample that covers all years from 2012 till 2017. As discussed in Section 3.2, trade facilitation data is only available for the years 2012, 2015 and 2017. We therefore also estimate the tariff semi-elasticity of missing imports in the sample only

covering years 2012, 2015 and 2017, which correspond to the years for which trade facilitation data is available. In baseline estimations we exclude tariffs above the 99$^{\text{th}}$ percentile, while we also provide a more conservative robustness check where only tariff rates above 100% are excluded.[5]

To estimate the moderating effect of trade facilitation on tariff evasion, we modify equation (3.1) as follows:

$$mi_{ikt} = \beta_1 \tau_{ikt} + \beta_2 (\tau_{ikt} \times \text{TF}^j_{it}) + \mathbf{FE}_{it} + \mathbf{FE}_{kt} + \mathbf{FE}_{ik} + \epsilon_{ikt} \tag{3.3}$$

where β_2 is the coefficient of interest. Equation (3.3) is estimated for each TF^j_{it}, where j = {IA,IT,AR,AP,FC,FM,CP,GI} indexes measures that cover different aspects of trade facilitation (see Section 3.2 and Table A-2). Further, we include a measure of average trade facilitation performance (TF^{AK}) and a synthetic measure of legal certainty (TF^{LC}), also described in Section 3.2 and Table A-2. According to Proposition 1, $\beta_2 < 0$, i.e., trade facilitation measures should weaken the positive relationship between tariff rate and missing imports.

3.1 Threats to identification

Omitted variable bias We use a rich set of fixed effects in all estimations to address plausible bias from omitted variables.

Importer-year fixed effects should control for the simultaneous impact of any time-varying country characteristics – such as institutional quality, level of development, endowments of productive factors, and technological advancements – on tariff levels and on evasion.

A second source of endogeneity can be from evolving global tastes that jointly affect tariff rates and evasion in certain product categories. Including product-year fixed effects accounts for this potential omitted variable bias.

Thirdly, lobbying activity of certain sectors may jointly determine missing imports and

[5]The 99$^{\text{th}}$ percentile tariff rate in our sample is 40%, while the maximum rate is 3000%.

tariff. For example, sectors using a high share of imported inputs sourced from the same sector might have a greater incentive to misreport imports and are also likely to lobby for lower tariffs. The inclusion of importer-product fixed effects controls for any product specific characteristics within an importer country, which should account for lobbying behavior assuming it does not vary over time.[6] Moreover, an importer may apply higher tax on HS6 products where it enjoys low elasticity of foreign export supply (Ludema and Mayda, 2013). These sectors could observe higher missing imports. The inclusion of importer-product fixed effects accounts for this source of omitted variable bias.

Reverse causality The coefficient of interest (β_2 in equation (3.3)) can still be biased due to reverse causality. For example, the government could try to insulate tariff revenue by setting tariff rates in inverse proportion to the missing imports (Fisman and Wei, 2004). While the inclusion of importer-product fixed effects should partially account for this possibility, evasion may become apparent over time and tariffs may be adjusted accordingly (Bussy, 2020). MFN tariffs, however, are determined through multilateral negotiations and it is unlikely that a country can independently set the such tariffs in response to missing imports.

Another concern is that missing imports could potentially affect trade facilitation measures. On balance, such a relationship is less probable, i.e. evasion within an HS6 product category is unlikely to guide a country-level policy change. However, tariff evasion in HS6 sectors that are most critical from tariff revenue perspective may provide incentive for an importing country to simplify its customs procedures (i.e. to improve its trade facilitation performance). We address the potential reverse causality from missing imports to trade facilitation in a robustness check, where we exclude HS6 sectors that are in the top decile according to their import shares within importer i.

[6] Our approach is similar to Ludema and Mayda (2013) who use importer-industry fixed effects to control for lobbying behavior.

Measurement error Missing imports may be estimated with a measurement error. Discrepancy in the values of mirror trade statistics can arise as exports are recorded in free on board (FOB) terms, while the imports are calculated including the cost of insurance and freight (CIF). These differences are unlikely to be systematically correlated with tariffs and therefore our estimator remains unbiased (Fisman and Wei, 2004). The measurement error can however make our estimator less efficient. This concern is alleviated as the time-invariant component of transport cost which is specific to a importer-product pair is accounted for in our specification, which includes importer-product fixed effects. Furthermore, importer-year fixed effects should also account for any improvement in national transport infrastructure which could be correlated with trade liberalization (Javorcik and Narciso, 2008).

3.2 Data and descriptive statistics

We construct a dataset that covers more than 120 countries and the whole set of HS6 product categories over the period 2012-2017 for our empirical analysis. This section describes the key variables and their sources, and presents some descriptive statistics.

3.2.1 Data

Tables A-1 and A-2 report a description of all variables used in the analysis.

Trade data and reporting discrepancies Trade and tariff data are sourced from UN COMTRADE and UNCTAD TRAINS, respectively, at the HS6 product classification. To construct the variable missing imports (which proxies discrepancy in trade statistics reported by partner countries), we collect both data on importer country i's reported value of HS6 product k's imports from the world, and data on the value of product k's exports reported by all other countries to country i. Regarding tariffs, we collect the most-favourite nation (MFN) tariffs of importing country i on product k.

Trade facilitation Trade facilitation data is sourced from the OECD Trade Facilitation Indicators (TFIs). The TFIs are composed of a set of eleven indicators, which mirror the substantive provisions of the WTO Trade Facilitation Agreement (TFA).[7] Each TF indicator is composed of several specific, precise and fact-based variables related to existing trade-related policies and regulations and their implementation in practice. There is a total of 133 variables, coded as 0, 1, or 2, where the top score (2) corresponds to the best performance. Each indicator is the unweighted average of the variables composing it.[8] The TFI database covers 163 countries, including economies at all income levels. The data is currently available for three waves, and roughly reflects policies in place around the years 2012, 2015 and 2017.

Table A-2 displays the set of TFIs used for the present analysis. The indicator Information Availability (that matches the requirements of Article I of the TFA), measures in its sub-indicators the extent to which a country provides web-based information on import and export procedures, whether the information is displayed in one of the official WTO languages, whether documents and forms are directly available for download on the customs website, and whether the country maintains an inquiry point and offers the possibility to ask questions on customs-related issues by telephone or internet.

The indicator Involvement of the trade community, which matches Article II of the TFA, covers the involvement of the trade community in the design of daily border-related operations. Such interaction helps designing a more transparent and predictable business environment for exporters (Fontagné, Orefice, and Piermartini, 2020).

The indicator Advance rulings, which matches Article III of the TFA, indicates whether the country provides the exporter with a ruling concerning the tariff classification, the origin and the valuation method that will apply to the good when it reaches the customs. The indicator Appeal procedures, which matches Article IV of the TFA, is related to the existence of the right to appeal

[7] The list of the eleven TF indicators, together with a description, is available in Table 1 of OECD (n.d.).

[8] See Annex table in OECD (n.d.) for the full list of variables and correspondence with the respective TF indicator.

to an administrative decision from customs. Since Advance rulings and Appeal procedures are, respectively, ex-ante and ex -post measures of legal certainty of border procedures, we also consider their (simple) average as a synthetic measure of Legal certainty (TF^{LC}).

The indicator Fees and charges, matching Article VI of the TFA, refers to the disciplines on fees and charges other than import and export duties and other than taxes, and on the penalties for a breach of customs laws, regulations, or procedural requirements. Article VI of the TFA mandates that fees and charges should be transparent, and penalties commensurate to the breach and procedurally fair.

The indicator Formalities, which matches articles VII and X of the TFA, is constructed, as in Fontagné, Orefice, and Piermartini (2020), as the simple average of three indicators: i) Formalities (documents), ii) Formalities (automation), and iii) Formalities (procedures). The first captures the extent to which the complexity of documents is simplified by relying on international standards, using copies, and reducing the number of documents. The second captures the implementation of automated procedures, electronic interchange of documents (EDI), and the application of risk management procedures. The third captures the development of a single window, and the existence of procedures to apply expedited customs clearance for traders.

The indicator Co-operation, which matches Article VIII of the TFA, is the simple average of tow indicators: i) Internal co-operation, and ii) External co-operation. The former is about co-operation between authorities and agencies responsible for border controls and procedures within the country, while the latter is about co-operation between such authorities and agencies across countries.

Finally, the indicator Governance and impartiality, which does not match any article of the TFA, is about transparency of customs structures and functions, as well as accountability and ethics policy.

We also compute the average TFI, TF^{AK}, as the simple average of all TF indicators.

Other variables We collect data on other variables to test the underlying mechanisms and to serve as additional controls. We include country-level variables such as GDP per capita (in current US$), which is sourced from the October 2018 edition of IMF's World Economic Outlook and control of corruption, which is sourced from the World Governance Indicators (WGI).[9] In addition, we collect data on two country-level variables that proxy overall customs efficiency. These variables include Days to import, which is sourced from World Bank's Doing Business indicators, and an index of customs performance from World Bank's Logistics Performance Index. At the product level we include a differentiated good dummy, which equals one if the HS6 product is differentiated, i.e. the product is neither traded on organized exchange nor does it have a reference price according to the Rauch (1999)'s (conservative) classification.[10]

3.2.2 Descriptive statistics

Table A-3 provides summary statistics for all variables that are used in the empirical analysis. Mean missing imports (in log) value is -0.04. The value is close to zero, which suggests that on average, mirror trade statistics reported by partner countries are comparable. The negative sign suggests that reported exports are on average smaller than reported imports.[11] This is expected since imports are calculated including the cost of insurance and freight (CIF). However, the upper tail of the missing imports' distribution consists of positive values. In fact, a quarter of all missing imports observations are positive, which suggests that imports could be systematically undervalued to avoid tariff charges. A graphical representation of missing imports, averaged across all products and the three years of the sample (2012, 2015, and 2017) for each country is provided in Figure A-1.

The mean (median) MFN tariff rate in our sample is equal to 6.71% (5%). As argued above,

[9]The control of corruption index is ranked on a scale of -2.5 to 2.5, with higher scores being associated with a stronger control of corruption.

[10]The data are at 4-digit level of aggregation of the SITC Rev. 2 classification. Standard crosswalks, available at `http://wits.worldbank.org/product_concordance.html`, are used to concord them to the HS 2007 classification.

[11]Missing imports are calculated as the difference between exports reported by all partner countries and the imports reported by the importing country (see equation (3.2)). A negative sign on missing imports implies that reported exports are less than reported imports.

only tariffs below the 99th percentile of the distribution are considered, therefore the maximum MFN tariff is 40%. While we discard prohibitive tariff rates (in some cases equal to 3000%), we provide a more conservative robustness check where only tariff rates above 100% are excluded.

4 Results

4.1 Trade facilitation performance and tariff evasion

Baseline results Table 1 presents the estimated effect of tariff rates on customs evasion. Each regression includes the most restrictive set of fixed effects: importer-year, importer-product and product-time. As expected, missing imports are increasing in MFN tariffs. The effect in column (1) is statistically significant at 1% level. The point estimate in column (1) suggests a tariff semi-elasticity of 0.3 for the period from 2012 until 2017. In other words, 1% increase in MFN tariff raises missing imports by 0.3%. While smaller in magnitude compared to the semi-elasticity reported by Fisman and Wei (2004), who only study the trade pattern between Hong Kong and China, this point estimate is similar to studies that use larger country samples (Javorcik and Narciso, 2008, Jean and Mitaritonna, 2010).[12] In columns (2) and (3) the tariff semi-elasticity is slightly smaller (0.2%) when we restrict the sample to years for which trade facilitation data is available.[13]

<< Table 1 about here >>

Having established that tariff evasion is ubiquitous across different samples, we assess if trade facilitation measures have a dampening effect on the phenomenon. In Table 2 we report the results from the interaction model (3.3). The coefficient of the TF interaction terms in columns

[12] Fisman and Wei (2004) report the tariff semi-elasticity of around 3 between Hong Kong and China. Javorcik and Narciso (2008) study the trade pattern between Germany and ten Eastern European countries, and find the tariff evasion estimate to be around 0.3%. In a cross-sectional study of 75 countries, Jean and Mitaritonna estimate the tariff semi-elasticity to be 0.24%. In a recent paper, Bussy (2020) uses a country-product sample that includes 190 countries and all HS6 categories. He studies tariff evasion between 1993 and 2017 and finds a slightly lower tariff semi-elasticity of 0.16%.

[13] Columns (2) and (3) of Table 1 use the same countries, but different sets of countries. The former uses all available countries, the latter is based on the same sample as Table 2.

(1)-(10) of Table 2 correspond to the coefficient of interest (β_2) for different trade facilitation policy measures. In column (1) the measure of average trade facilitation performance (TF^{AK}) interacted with MFN tariff is negative and statistically significant at 10% level. The negative sign of the interaction term suggests that improving trade facilitation performance has a dampening effect on tariff evasion. The point estimate implies that holding tariff rate constant at its mean, one standard deviation improvement in trade facilitation performance reduces missing imports by 6.04% (see panel (i) of Figure 2). This result confirms Proposition 1, i.e. improvement in trade facilitation performance weakens the positive effect of tariffs on customs evasion.

<< Table 2 and Figure 2 about here >>

We next unpack the effectiveness of different trade facilitation policies in reducing tariff evasion. The impact of overall TF is accounted for by information on advance rulings (TF^{AR}) and, to a smaller extent, appeal procedures (TF^{AP}). These results are consistent with Hillberry and Zhang (2018), who find that trade facilitation measures related to procedures, and to a lesser extent advance rulings help reducing import time. As argued in Section 3.2, we construct TF^{LC} as a synthetic measure of legal certainty brought about by information on advance rulings and appeal procedures. Its impact is negative and statistically significant at the 1% level, as shown in column (10) of Table 2. Holding tariff constant at its mean, one standard deviation improvement in the measure of legal certainty reduces missing imports by 12% (see panel (ii) of Figure 2).

The evasion-augmenting effect of trade facilitation measure related to the involvement of the trading community (TF^{IT}) in column (3) is somewhat puzzling. Fontagné, Orefice, and Piermartini (2020) find that the measure related to involvement of the trading community does not benefit small firms at destination, and could even hamper their trade margin by increasing competition.

Robustness checks We perform several checks on the main result related to the overall trade facilitation performance (TF^{AK}) and legal certainty (TF^{LC}). First, we exclude sectors that are in top decile of the distribution of import shares in country i. These sectors could plausibly drive a reverse causal relationship between missing imports and trade facilitation. Results presented in columns (1)-(2) of Table 3 show that excluding these sectors do not affect our estimate of overall trade facilitation performance and legal certainty. These results suggest that missing imports in HS6 sectors do not influence country-level trade facilitation measures. Next, instead of excluding tariffs in top 99^{th} percentile, we apply a more conservative criteria and exclude tariff rates over 100%. This criterion excludes less than 2,500 observations from the full estimation sample (approximately 1.4 million observations). Results presented in columns (3)-(4) of Table 3 show that measures of average trade facilitation performance and legal certainty continue to significantly dampen tariff evasion (the point estimate on the legal certainty measure is smaller). Columns (5)-(6) present the results after clustering standard errors at the country-level. While the coefficient for overall trade facilitation performance becomes largely statistically insignificant, the coefficient for legal certainty is almost significant at 10% level (p value=0.105).[14] Finally, we test whether our trade facilitation measures could be capturing other country characteristics whose effect on missing imports may vary with the level of tariff. In columns (7)-(8) of Table 3 we include interactions between HS6 tariffs and (the log of) GDP per capita, and between HS6 tariffs and two other customs performance proxies: time to import (in days) and the efficiency of customs and border management clearance (LPI customs index). The effect of trade facilitation performance and legal certainty is robust to inclusion of these additional interactions.

<< Table 3 about here >>

Overall, results presented in this section highlight two main findings. First, we find that average trade facilitation performance weakens the positive relationship between missing imports

[14]Further, the coefficient for advanced rulings remains statistically significant at 5% level even when standard errors are clustered at the country-level.

and MFN tariff. Second, this effect is driven by pre-shipment and post-shipment legal certainty of border procedures. We devote the rest of the analysis to understanding the particularly salient effect of legal certainty. We first perform a counterfactual exercise where we assess the effect of a full tariff liberalization conditional on the observed levels of legal certainty of border procedures in country i. Next, we identity which potential channels of tariff evasion are sensitive to legal certainty of border procedures. Finally, we explore whether legal certainty's effect on tariff evasion varies according to country characteristics. In particular, we test Proposition 2, which predicts that legal certainty can be especially effective in curbing tariff evasion in countries with low control of corruption.

4.2 Quantification

We conduct an exercise similar to Beverelli, Fiorini, and Hoekman (2017), who estimate the impact of full services trade liberalization on manufacturing productivity in a sample of 57 countries and 18 sectors. Column (1) of Table 4 reports for each country the estimated impact of full tariff liberalization, averaged across all years and all sectors used in the baseline estimations of column (10) of Table 2. Note that the number of countries in the table is 61, while the number of countries in Table 2 is 121. This is because Table 4 only includes countries for which the estimated marginal effects are significant at the 5% level. The numbers in column (1) of Table 4 should be interpreted as the estimated percentage change in missing imports (without the log transformation). Column (2) of Table 4 compares the percentage change in missing imports in each country with that of a reference country, Israel.[15] The column reports the average across all sectors and years of all the differences in the marginal effects between each country and the reference country.

<< Table 4 about here >>

The effect is decomposed into two parts. The first column (column (3)) reflects heterogeneity

[15]We select Israel as the reference country since the effect of full tariff liberalization on its missing imports is equivalent to the average effect of full liberalization in the sample.

in MFN tariff rates, which implies that a different policy change is needed in each country to attain full liberalization. In particular, column (3) reports the difference in the marginal effects after aligning the trade facilitation attainment of each country with that of the reference country. Intuitively, the values in column (3) answer the question, "what would be the difference in the marginal effect on missing imports of liberalization if the trade facilitation context were the same as in the reference country?", and therefore captures the impact of heterogeneity in levels of tariff liberalization. The next column (column (4)) reflects heterogeneity in legal certainty of border procedures that prevails across countries. Column (4) is obtained by subtracting the policy contribution from the overall difference, that is, (2) minus (3), and provides a measure of the role of legal certainty in generating the difference in the marginal effect on missing imports. Finally, columns (5) and (6) rank countries according to their average level of MFN tariff and TF^{LC}, respectively.[16]

Clearly, countries with low levels of legal certainty and high tariffs stand to gain most from a tariff liberalization, both in absolute terms and in comparison to the reference country. Compare the country with highest average MFN tariffs and the lowest score on TF^{LC}, the Central African Republic, with a country with similarly high MFN tariffs, but significantly higher TF^{LC}, Ethiopia. In absolute terms, the Central African Republic would experience a 10.46% reduction in missing imports under a full tariff cut scenario, compared with a 4.63% reduction in Ethiopia. Relative to the reference country (Israel), the reduction in missing imports would be 9.43% in the Central African Republic and 3.85% in Ethiopia. 70% of the relative reduction in missing imports in the Central African Republic (6.59 out of 9.43) is driven by legal certainty (column (4) of Table 4), and the remaining 30 percent (2.84 out of 9.43) is driven by tariffs (column (3)). In the case of Ethiopia, these numbers are the opposite, i.e. 70% of the relative reduction in missing imports (2.58 out of 3.85) is driven by tariffs (column (3) of Table 4), and the remaining

[16]The rankings in columns (5) and (6) of Table 4 range between 1 and 121 (the latter being the number of countries included in the benchmark estimations of Table 2). For MFN tariff (column (5)), the lower the ranking, the lower average MFN tariff is across years and sectors. For TF^{LC} (column (6)), the lower the ranking, the higher is the legal certainty of border procedures.

30% (1.16 out of 3.85) is driven by legal certainty. These large differences are due to the fact that Ethiopia is relatively more different from the reference country (Israel) in terms of average tariffs (see column (5) of Table 4) than in terms of average TF^{LC} (see column (6) of Table 4) than the Central African Republic.

4.3 Channels of tariff evasion and legal certainty

Existing literature identifies three channels through which tariff evasion can occur. First, tariff evasion can occur through mis-classification of products i.e. an importer could report a higher taxed product as a lower taxed variety (Fisman and Wei, 2004). Second, tariff evasion can occur through under-reporting of unit prices (Javorcik and Narciso, 2008, 2017). Finally, tariff evasion can occur through under-declaration of product quantities (Rotunno and Vézina, 2012).

We modify the baseline interaction model (3.3) and introduce product-level characteristics that identify the potential channel of tariff evasion. First, we create a dummy variable that equals one if, within each country and year, the HS6 product tariff is higher than the average tariff on similar goods (Fisman and Wei, 2004).[17] Lower average tariff rate on similar products would increase the incentive to evade through mis-classification. A positive sign on the interaction between the above described HS4 tariff dummy and HS6 tariff would imply evasion through mis-classification. Finally, we interact the mis-classification proxy with our synthetic measure of legal certainty. The triple interaction term identifies whether improving legal certainty can reduce tariff evasion that occurs through mis-classification of products. Results presented in Column (1) of Table 5 fail to detect any effect of improving legal certainty on reducing evasion through mis-classification of products.

<< Table 5 about here >>

Next, we ask whether legal certainty can dampen evasion that occurs through under-reporting of unit prices. We modify the baseline interaction model in two ways. First, we

[17] Similar products are defined as all other products in same HS4 heading. That is, HS6 product k is excluded from the average.

follow the literature on detecting evasion through under-reporting and use unit value gap as our dependent variable (Javorcik and Narciso, 2017). We define unit value gap as the difference in unit values of exports of HS6 product k in year t that is reported by the world and by the importer:

$$uvg_{ikt} \equiv \ln\left(\frac{1+X_{ikt}}{1+X^{Q}_{ikt}}\right) - \ln\left(\frac{1+M_{ikt}}{1+M^{Q}_{ikt}}\right), \tag{4.1}$$

where X^{Q}_{ikt} (X^{Q}_{ikt}) is the value (quantity) of exports reported by all exporting countries to importing country i in sector k at time t, and M_{ikt} (M^{Q}_{ikt}) is the value (quantity) of imports reported by country i from all countries in sector k at time t. Second, we add a dummy variable that equals one if the HS6 product is differentiated according to the conservative version of Rauch's (1999) classification. Differentiated products are those products whose price may range widely because of product quality, and therefore it may be difficult to detect under-pricing (Javorcik and Narciso, 2017). A positive sign on the interaction between the Differentiated dummy and tariff rate would imply that evasion happens through under-reporting of unit prices. Further, we interact this proxy of evasion through under-reporting with our synthetic measure of legal certainty to assess whether it can potentially dampen evasion through under-pricing. Results presented in column (2) of Table 5 suggest that improving legal certainty significantly reduces evasion that occurs through under-reporting of unit prices.

Lastly, we test whether legal certainty could reduce evasion through under-declaration of product quantities. Once more we modify the baseline interaction model model in two ways. Following Javorcik and Narciso (2017), we calculate the dependent variable as the log ratio of the quantity of exports relative to the quantity of imports:

$$mi^{Q}_{ikt} \equiv \ln\left(1+X^{Q}_{ikt}\right) - \ln\left(1+M^{Q}_{ikt}\right). \tag{4.2}$$

Next, we add a dummy variable that equals one if the HS6 product is not measured in kilos (Non-kilo dummy). The idea is that it is easier to weigh a container than count number of packaged

units (Rotunno and Vézina, 2012). Hence HS6 products that are reported in kilograms would be more difficult to evade through under-declaration of quantity. A positive sign on the interaction between the Non-kilo dummy and tariff rate would imply that evasion in HS6 category happens through under-declaration of quantity. Finally, we interact the proxy for evasion through under-declaration with our synthetic measure of legal certainty to identity whether improving legal certainty reduces evasion through under-declaration of quantities. Results presented in Column (3) of Table 5 suggest that improving legal certainty significantly reduces evasion that occurs through under-declaration of product quantities.

4.4 Control of corruption and legal certainty

So far we have assessed the overall dampening effect of legal certainty on tariff evasion, which is plausibly due to lowering the cost of customs procedures (Proposition 1). However, the relationship between legal certainty and tariff evasion can be mediated by country-level control of corruption. This is because importers in countries with low control of corruption can avoid detection of tariff evasion by offering side payments to customs officials. Improving legal certainty of border procedures can reduce the discretionary power of officials to apply rules arbitrarily. Hence legal certainty should have an additional dampening effect on tariff evasion through harmonizing rules in countries with low control of corruption (Proposition 2).

We modify the baseline interaction model (3.3) and include a proxy for country-level control of corruption, a dummy that equals one when the control of corruption (CC) is below a given threshold, Low CC dummy.[18] Next, we interact the Low CC dummy with Tariff and with TF^{LC}. A negative sign on the triple interaction term would imply that improving legal certainty has an additional dampening effect on tariff evasion in countries with low control of corruption. Results presented in Table 6 suggest that improving legal certainty has an additional dampening effect on tariff evasion in country with lowest control of corruption: the triple interaction is only

[18] We define three different Low CC dummies. The first is based on the 10^{th} percentile of the control of corruption index as threshold. The second is based on the 25^{th} percentile of the control of corruption index as threshold. The third is based on the 50^{th} percentile of the control of corruption index as threshold.

significant when the 10^{th} percentile of the control of corruption index is used as threshold to construct the Low CC dummy. This dampening effect of improving legal certainty in countries with very low levels of control of corruption is likely to occur through reducing the discretionary power of customs officials.

<< Table 6 about here >>

5 Conclusions

This paper has shown that improvement in customs administration has an attenuating effect on tariff evasion, which has proven to be one of the most resilient form of trade costs. Using a dataset covering more than 120 countries and nearly 5000 product categories for the years 2012, 2015, and 2017, we have shown that improving legal certainty of border procedures weakens the positive effect of tariffs on missing imports. Improving legal certainty is especially effective in curbing tariff evasion that occurs through under-reporting of unit prices and through under under-declaration of product quantities. Finally, we have also shown that improving legal certainty is likely to yield greater gains in countries with low control of corruption, through a reduction in the discretionary power of customs officials.

Our results suggest that policy makers can introduce trade facilitation measures in a piece-meal fashion if the primary objective is to minimize tariff evasion in a cost-effective manner. We corroborate the Trade Facilitation Agreement's novel approach to eschew a one-size-fits-all model and encourage WTO member countries to adopt policies that are most effective in reducing trade bottlenecks.

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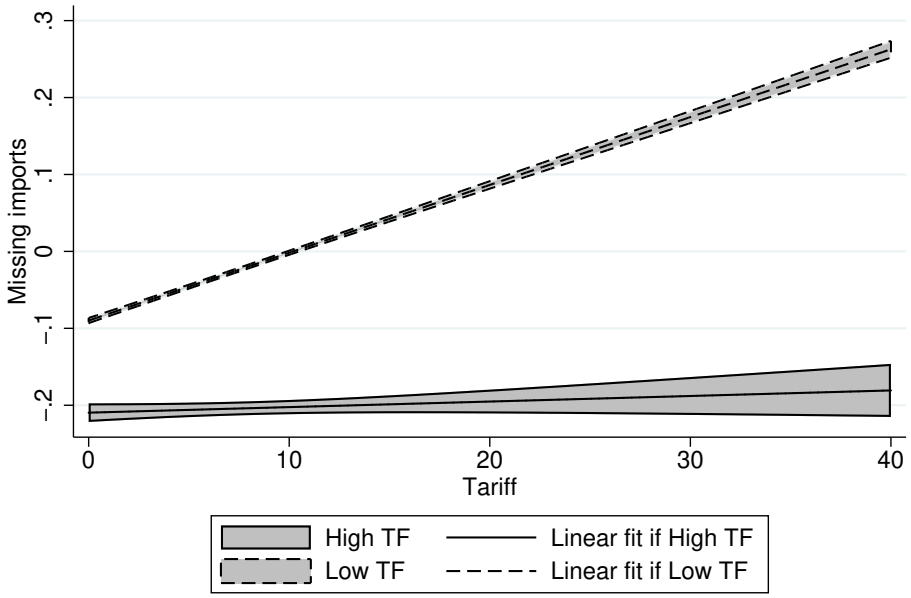
Figures and tables

Figure 1: Trade facilitation and tariff evasion: motivation



Notes: Missing imports defined in equation (3.2). Indicator used: TF^{AK} (see Table A-2). The sample is the one of column (1) of Table 2. High TF is a dummy equal to one if TF^{AK} is above its sample median.

Table 1: Tariff rate and missing imports

	(1)	(2)	(3)
Tariff	0.003**	0.002*	0.002*
	(0.001)	(0.001)	(0.001)
Observations	2,819,258	1,324,891	1,187,684
No. of countries	155	137	121
No. of HS 6	4975	4916	4863

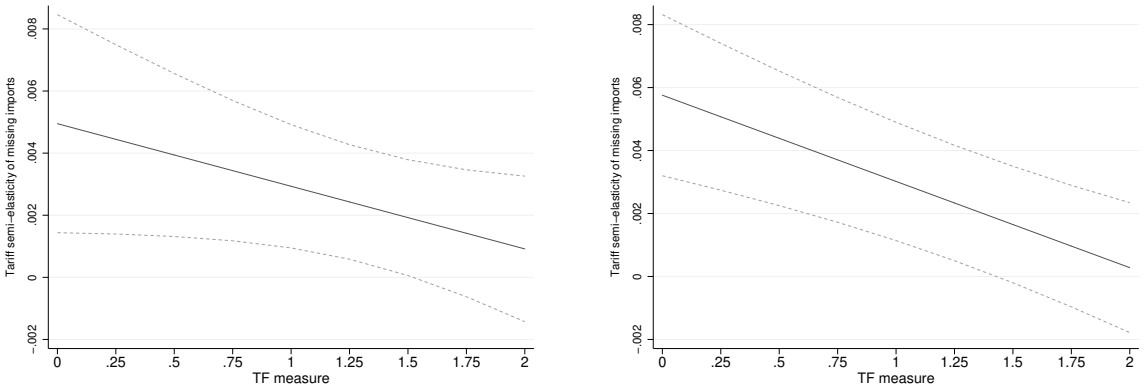
Notes: $^{+}$p<0.10, *p<0.05,**p<0.01. Dependent variable: missing imports, defined in equation (3.2). Robust standard errors in parentheses. Country-year, country-product (HS6) and product-year fixed effects included in all specifications. Column (1) includes years 2012-2017. Column (2) includes years 2012, 2015, and 2017. Column (3) uses the same sample as columns (1) and (10) of Table 2. See tables A-1 and A-2 for variables' descriptions.

Table 2: Trade facilitation and tariff evasion

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Tariff	0.005**	0.004*	0.001	0.006**	0.004**	0.001	0.003*	0.003**	0.003*	0.006**
	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Tariff × TF^{AK}	-0.002^{+}									
	(0.001)									
Tariff × TF^{IA}		-0.001								
		(0.001)								
Tariff × TF^{IT}			0.001*							
			(0.001)							
Tariff × TF^{AR}				-0.004**						
				(0.001)						
Tariff × TF^{AP}					-0.001*					
					(0.001)					
Tariff × TF^{FC}						0.001				
						(0.001)				
Tariff × TF^{FM}							-0.000			
							(0.001)			
Tariff × TF^{CP}								-0.001		
								(0.000)		
Tariff × TF_{GI}									-0.000	
									(0.001)	
Tariff × TF^{LC}										-0.003**
										(0.001)
Observations	1,187,684	1,187,684	1,143,541	1,124,212	1,156,742	1,112,370	1,187,684	1,173,937	1,115,283	1,187,684
No. of countries	121	121	115	115	116	110	121	119	113	121
No. of HS 6	4863	4863	4863	4863	4863	4863	4863	4863	4863	4863

Notes: $^{+}$p<0.10, *p<0.05,**p<0.01. Dependent variable: missing imports, defined in equation (3.2). Robust standard errors in parentheses. Country-year, country-product (HS6) and product-year fixed effects included in all specifications. Years included: 2012, 2015, and 2017. See tables A-1 and A-2 for variables' descriptions.

Figure 2: Average TF and Legal Certainty: marginal effects



(i) TF^{AK} (ii) TF^{LC}

Notes: Marginal effects in panel (i) are computed from the estimates in column (1) of Table 2. Marginal effects in panel (ii) are computed from the estimates in column (10) of Table 2. 95% confidence intervals based on the Delta method. See tables A-1 and A-2 for variables' descriptions.

Table 3: Average TF and legal certainty: robustness

	Excluding large import shares		Excluding tariff > 100%		Clustered standard errors		Additional interactions	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Tariff	0.005*	0.006**	0.004**	0.004**	0.005	0.006^{+}	0.005*	0.005**
	(0.002)	(0.001)	(0.001)	(0.001)	(0.004)	(0.003)	(0.002)	(0.002)
Tariff × TF^{AK}	-0.002^{+}		-0.002^{+}		-0.002		-0.003*	
	(0.001)		(0.001)		(0.003)		(0.001)	
Tariff × TF^{LC}		-0.003**		-0.002**		-0.003		-0.003**
		(0.001)		(0.001)		(0.002)		(0.001)
Tariff × GDP_{pc}							0.002	0.004
							(0.005)	(0.005)
Tariff × DB_{time}							-0.001**	-0.001**
							(0.000)	(0.000)
Tariff × $LPI_{cust.}$							0.006	0.001
							(0.017)	(0.017)
Observations	1,047,798	1,047,798	1,198,981	1,198,981	1,187,684	1,187,684	1,165,416	1,165,416
No. of countries	121	121	121	121	121	121	116	116
No. of HS 6	4851	4851	4864	4864	4863	4863	4863	4863

Notes: $^{+}$p<0.10, *p<0.05,**p<0.01. Dependent variable: missing imports, defined in equation (3.2). Robust standard errors in parentheses, except in columns (5) and (6) where standard errors are clustered at the country-level. Country-year, country-product (HS6) and product-year fixed effects included in all specifications. Years included: 2012, 2015, and 2017. See tables A-1 and A-2 for variables' descriptions.

Table 4: Quantification

Country	ISO3	%ΔMI	%ΔMI – $\%\Delta MI_{RC}$	Components of (2)		Country rankings	
			(3) + (4)	Tariff	TF^{LC}	Tariff	TF^{LC}
		(1)	(2)	(3)	(4)	(5)	(6)
Central African Republic	CAF	-10.46	-9.43	-2.84	-6.59	121	121
Malawi	MWI	-6.73	-5.61	-1.72	-3.89	110	118
Burkina Faso	BFA	-6.52	-5.57	-1.71	-3.86	106	117
Bangladesh	BGD	-6.33	-5.43	-2.02	-3.41	115	114
Benin	BEN	-5.51	-4.48	-1.74	-2.73	112	111
Antigua and Barbuda	ATG	-5.48	-4.28	-1.50	-2.78	107	112
Maldives	MDV	-5.38	-4.57	-1.28	-3.29	94	116
Togo	TGO	-5.14	-4.19	-1.74	-2.45	109	108
Solomon Islands	SLB	-5.01	-3.96	-0.83	-3.13	84	119
Rwanda	RWA	-4.87	-3.90	-1.81	-2.09	114	102
Mali	MLI	-4.80	-3.87	-1.69	-2.18	104	106
Belize	BLZ	-4.71	-3.61	-1.16	-2.45	92	113
Ethiopia	ETH	-4.63	-3.85	-2.68	-1.16	119	85
Zimbabwe	ZWE	-4.63	-3.82	-1.92	-1.89	111	100
Samoa	WSM	-4.47	-3.42	-1.33	-2.09	97	107
Cote d'Ivoire	CIV	-3.81	-2.95	-1.73	-1.22	103	93
Eswatini	SWZ	-3.79	-2.98	-0.76	-2.22	79	115
Tunisia	TUN	-3.58	-2.71	-2.02	-0.70	117	81
Zambia	ZMB	-3.58	-2.64	-1.83	-0.81	113	83
Uganda	UGA	-3.54	-2.68	-1.72	-0.96	102	87
Jamaica	JAM	-3.49	-2.13	-0.87	-1.26	88	101
Madagascar	MDG	-3.35	-2.52	-1.61	-0.91	100	86
Tanzania	TZA	-3.32	-2.52	-1.72	-0.80	101	84
Fiji	FJI	-3.30	-2.36	-1.35	-1.01	95	92
Bolivia	BOL	-3.10	-2.44	-1.73	-0.71	98	82
Paraguay	PRY	-3.03	-2.22	-1.39	-0.84	93	89
Lesotho	LSO	-3.01	-2.11	-0.81	-1.30	81	104
Angola	AGO	-2.90	-2.24	-0.74	-1.50	70	110
Nepal	NPL	-2.88	-2.15	-1.69	-0.46	99	76
Uruguay	URY	-2.82	-2.08	-1.55	-0.53	96	79
Argentina	ARG	-2.73	-2.17	-2.28	0.11	116	64
Egypt	EGY	-2.63	-2.02	-1.25	-0.77	83	90
Ecuador	ECU	-2.61	-2.05	-1.58	-0.47	91	77
Namibia	NAM	-2.61	-1.86	-0.71	-1.16	71	105
Botswana	BWA	-2.41	-1.60	-0.74	-0.85	78	95
Dominican Republic	DOM	-2.35	-1.49	-0.71	-0.78	77	94
Panama	PAN	-2.29	-1.34	-0.47	-0.87	67	98
Morocco	MAR	-2.16	-1.42	-1.34	-0.08	90	70
Belarus	BLR	-2.06	-1.12	-0.62	-0.50	73	88
Lebanon	LBN	-1.97	-1.22	-0.37	-0.85	56	103
China	CHN	-1.95	-1.26	-1.23	-0.04	86	69
Indonesia	IDN	-1.78	-1.28	-0.98	-0.30	75	74
Sri Lanka	LKA	-1.66	-0.84	-0.83	0.00	80	68
Palau	PLW	-1.58	-0.53	0.47	-1.01	10	120
Qatar	QAT	-1.54	-0.77	-0.15	-0.62	23	99
El Salvador	SLV	-1.50	-0.63	-0.38	-0.24	63	78
Kuwait	KWT	-1.49	-0.73	-0.16	-0.57	28	97
United Arab Emirates	ARE	-1.48	-0.79	-0.23	-0.56	26	96
Mexico	MEX	-1.45	-0.71	-0.55	-0.16	64	71
Honduras	HND	-1.38	-0.51	-0.34	-0.16	60	73
Kazakhstan	KAZ	-1.38	-0.52	-0.63	0.11	74	59
Saudi Arabia	SAU	-1.35	-0.64	-0.24	-0.40	48	91
Mongolia	MNG	-1.29	-0.41	-0.15	-0.25	53	80
Chile	CHL	-1.17	-0.47	-0.51	0.04	62	65
Kyrgyz Republic	KGZ	-1.12	-0.41	-0.51	0.10	61	60
Oman	OMN	-1.09	-0.35	-0.18	-0.17	30	75
Armenia	ARM	-1.09	-0.38	-0.43	0.05	57	63
Guatemala	GTM	-1.08	-0.29	-0.36	0.07	58	62
Bahrain	BHR	-1.05	-0.26	-0.14	-0.12	32	72
Italy	ITA	-0.85	-0.14	-0.21	0.07	19	61
Israel	**ISR**	**-0.70**	**0**	**0**	**0**	**13**	**67**
Georgia	GEO	-0.63	0.27	0.54	-0.27	5	109
New Zealand	NZL	-0.46	0.23	0.22	0.01	6	66

Notes: Reference country (RC) for columns (2)-(4): Israel (indicated in bold). MI = missing imports of equation (3.2) without the log transformation. Only countries for which the estimated marginal effects from regressions in column (10) of Table 2 are significant at the 5% level are included in the table. Tariff and TF^{LC} respectively defined in tables A-1 and A-2.

Table 5: Legal certainty: channels of tariff evasion

	Misreporting	Underinvoicing	Underdeclaration of quantities
	(1)	(2)	(3)
Tariff	0.006**	-0.000	0.001
	(0.002)	(0.002)	(0.002)
Tariff × TF^{LC}	-0.003**	0.001	0.001
	(0.001)	(0.001)	(0.001)
Tariff × HS4 tariff dummy	0.000		
	(0.002)		
Tariff × HS4 tariff dummy × TF^{LC}	-0.001		
	(0.001)		
Tariff × Differentiated dummy		0.006*	
		(0.003)	
Tariff × Differentiated dummy × TF^{LC}		-0.004**	
		(0.001)	
Tariff × Non-kilo dummy			0.004
			(0.004)
Tariff × Non-kilo dummy × TF^{LC}			-0.006**
			(0.002)
Observations	1,186,788	922,853	1,027,091
No. of countries	121	121	121
No. of HS 6	4863	4403	4856

Notes: $^{+}$p<0.10, *p<0.05,**p<0.01. Dependent variable: missing imports in values, defined in equation (3.2) in column (1); unit value gap, defined in equation (4.1) in column (2); missing imports in quantities, defined in equation (4.2) in column (3). Robust standard errors in parentheses. Country-year, country-product (HS6) and product-year fixed effects included in all specifications. Years included: 2012, 2015, and 2017. See tables A-1 and A-2 for variables' descriptions.

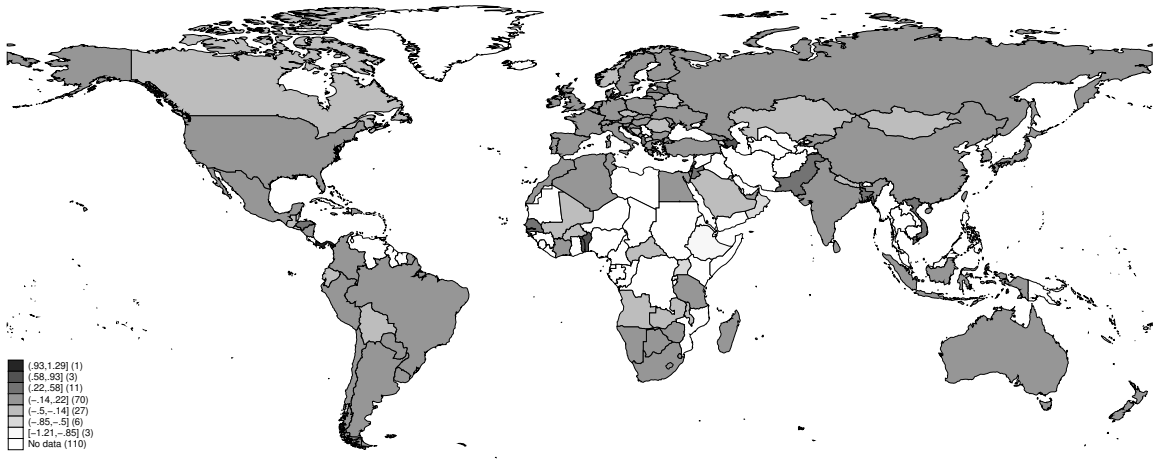
Table 6: country-level control of corruption and legal certainty

	Control of corruption (CC) percentile		
	10^{th}	25^{th}	50^{th}
	(1)	(2)	(3)
Tariff	0.007**	0.005**	0.007**
	(0.001)	(0.001)	(0.002)
Tariff × TF^{LC}	-0.003**	-0.002**	-0.002*
	(0.001)	(0.001)	(0.001)
Tariff × Low CC dummy	0.000	0.003^{+}	-0.001
	(0.005)	(0.002)	(0.002)
Tariff × Low CC dummy ×TF^{LC}	-0.007*	-0.002	-0.001
	(0.004)	(0.001)	(0.001)
Observations	1,187,684	1,187,684	1,187,684
No. of countries	121	121	121
No. of HS 6	4863	4863	4863

Notes: $^{+}$p<0.10, *p<0.05,**p<0.01. Dependent variable: missing imports in values, defined in equation (3.2) in column (1). Robust standard errors in parentheses. Country-year, country-product (HS6) and product-year fixed effects included in all specifications. Years included: 2012, 2015, and 2017. See tables A-1 and A-2 for variables' descriptions.

Appendix figures and tables

Figure A-1: Missing imports, country-level averages



Notes: Countries covered: 163. See Table A-1 for the description of missing imports. Averages computed across the years of TF data availability (2012, 2015, and 2017).

Table A-1: Variables' description

Variable	Description	Data source
Missing imports (values)	Log difference in value of exports reported by all exporting countries to importing country i in sector k at time t (X_{ikt}) and value imports reported by country i from all countries (M_{ikt}). See equation (3.2)	UN Comtrade
Unit value gap	Log difference in the unit value of exports reported by all exporting countries to importing country i in sector k at time t and unit value of imports reported by i from all countries. See equation (4.1)	– ''–
Missing imports (quantities)	Log difference in the quantity of exports reported by all exporting countries to importing country i in sector k at time t and quantity of imports reported by country i from all countries. See equation (4.2)	– ''–
Tariff	Log of MFN applied tariff of importing country i in sector k	UNCTAD TRAINS
TF^j	See Table A-2	OECD TFIs
GDP_{pc}	Log of gross domestic product per capita	IMF WEO
DB_{time}	Number of days to import	World Bank DB
$LPI_{cust.}$	Efficiency of customs and border management clearance	World Bank LPI
HS4 tariff dummy	Dummy equal to one if the tariff in sector k in importer i in year t is greater than its corresponding HS4 average (excluding sector k's tariff from the average)	UNCTAD TRAINS
Differentiated dummy	Dummy equal to one if k has no reference price and k's price is not quoted on an organized exchange	Rauch (1999)
Non-kilo dummy	Dummy equal to one if, within i, k is never reported in kilograms between 2012 and 2017	UN Comtrade
Low CC dummy (10^{th} percentile)	Dummy equal to one for observations if the Control of Corruption (CC) index is below its 10^{th} percentile	World Bank WGI's
Low CC dummy (25^{th} percentile)	Dummy equal to one for observations if the Control of Corruption (CC) index is below its 25^{th} percentile	– ''–
Low CC dummy (50^{th} percentile)	Dummy equal to one for observations if the Control of Corruption (CC) index is below its 50^{th} percentile	– ''–

Notes: TF^j = Trade Facilitation indicator j, $j = \{IA, IT, AR, AP, FC, FM, CP, GI\}$. DB = Doing Business. LPI = Logistics Performance Index. TFIs = Trade Facilitation Indicators. WEO = World Economic Outlook. WGI's = World Governance Indicators.

Table A-2: TFI indicators used

	Indicator	Variable name	Description	WTO TFA article
(a)	Information availability	TF^{IA}	Enquiry points; publication of trade information, including on Internet	I
(b)	Involvement of the trade community (consultations)	TF^{IT}	Structures for consultations; established guidelines for consultations; publications of drafts; existence of notice-and-comment frameworks	II
(c)	Advance rulings	TF^{AR}	Prior statements by the administration to requesting traders concerning the classification, origin, valuation method, etc. applied to specific goods at the time of importation; the rules and process applied to such statements	III
(d)	Appeal procedures	TF^{AP}	The possibility and modalities to appeal administrative decisions by border agencies	IV
(e)	Fees and charges	TF^{FC}	Disciplines on the fees and charges imposed on imports and exports; disciplines on penalties	VI
(f, g, h)	Formalities	TF^{FM}	Average of (f) Formalities (documents), (g) Formalities (automation), and (h) Formalities (procedures)	VII, X
(i, j)	Cooperation	TF^{CP}	Average of (i) Internal cooperation, and (j) External cooperation	VIII
(k)	Governance and impartiality	TF_{GI}	Customs structures and functions; accountability; ethics policy	–
Averages				
(a)-(k)	AK Average	TF^{AK}	Simple average of TF^{IA}, TF^{IT}, TF^{LC}, TF^{FC}, TF^{FM}, TF^{CP}, and TF_{GI}	
(c, d)	Legal certainty	TF^{LC}	Simple average of TF^{AR} and TF^{AP}	

Notes: See Table 1 in OECD (n.d.) for the description of TFI indicators (f) Formalities (documents), (g) Formalities (automation), (h) Formalities (procedures), (i) Internal co-operation, and (j) External co-operation. TFI indicator (k) Governance and impartiality is outside the scope of the WTO's Trade Facilitation Agreement (TFA).

Table A-3: Descriptive statistics

Variable	Mean	Median	Std Dev	Min	Max
Missing imports (values)	-0.04	-0.06	1.37	-15.26	13.79
Unit value gap	0.11	-0.01	1.26	-22.48	28.03
Missing imports (quantities)	-0.14	-0.05	1.98	-28.00	23.25
Tariff	6.71	5.00	7.53	0	40
TF^{AK}	1.39	1.44	0.30	0.28	1.93
TF^{IA}	1.61	1.65	0.29	0	2
TF^{IT}	1.40	1.50	0.48	0	2
TF^{AR}	1.36	1.50	0.60	0	2
TF^{AP}	1.49	1.50	0.39	0	2
TF^{FC}	1.44	1.50	0.48	0	2
TF^{FM}	1.34	1.38	0.35	0.33	2
TF^{CP}	1.27	1.33	0.57	0	2
TF^{GI}	1.53	1.71	0.48	0	2
TF^{LC}	1.40	1.51	0.44	0	2
GDP_{pc}	9.21	9.28	1.31	5.87	11.57
DB_{time}	18.03	15.00	12.60	4.00	73.75
$LPI_{cust.}$	2.95	2.83	0.57	2.05	4.09
Variable	Zeros	Ones	Std Dev	Min	Max
HS4 tariff dummy	940,793	245,995	0.41	0	1
Differentiated dummy	321,748	601,105	0.48	0	1
Non-kilo dummy	734,313	292,778	0.45	0	1
Low CC dummy (10^{th} percentile)	1,142,106	45,578	0.19	0	1
Low CC dummy (25^{th} percentile)	977,087	210,597	0.38	0	1
Low CC dummy (50^{th} percentile)	662,674	525,010	0.50	0	1

Notes: See tables A-1 and A-2 for variables' description.